In the Specification:

Please amend the sixth paragraph on page 9 as follows:

--Figures 46a-46b are graphs illustrating wavelength and airgap dependence of polarization characteristics of polarizing grid suspended in air for grid pitch equal to ~~25□m~~ 25μm;--

Please amend the third full paragraph on page 11 as follows:

--Returning to Figure 2, source 12 emits s-mmw radiation to diffuser 14, which diffusively reflects the radiation toward ~~object 16~~ object 3. The diffuser 14 also essentially decreases the spatial coherence of the radiation in the field of view. This feature improves the imaging properties of the system 10 due to the reduction of spatial coherent related noises such as speckle and glint or glare. This result is valid for quasi-monochromatic radiation as well as for multi-frequency radiation. In the latter case, the system is more effective in reduction of the coherence level because both spatial and temporal coherence of illuminated radiation are simultaneously reduced.--

Please amend the fourth full paragraph on page 21 as follows:

--In the preferred embodiment, a set of driving units 109 provide supply currents for each of the ~~sources 105~~ sources 12a, 12b, ... and set of FM/(AM) modulators 108 are intended for distinct modulation of the radiation emitted by the different partial sources.--

Please amend the third full paragraph on page 23 as follows:

--This signal is multiplexed to the sampling unit 110 and after A/D conversion further processed by the pre- and main processor 111 and 113. The two-dimensional array of second electrical signals produces a partial image presentation of the target. An algorithm is implemented to calculate an average factor or another statistical quantity for normalization of the second electrical signals over all the elements of the array 18. This normalized number will be used to weigh the intensity of this frequency interval. This method of calibration is of the sequential type. By repeating this procedure for each

~~generator 12.n,~~ generator 12n, the multi-frequency source is tuned over the whole frequency range of interest.--

Please amend the first paragraph on page 24 as follows:

--Another method for calibrating the system is of the concurrent type. The partial source generator for each frequency interval is amplitude or frequency modulated by a different LF signal, e.g., generated by modulation unit 108. All the frequency-modulated signals are directed towards the diffuser array 14 (Figure 2) via the horn 107 and from there to the object 16 (Figure 2). The radiation reflected and scattered by the object 16 is then focused on the elements of the detector array ~~18.a, 18.n.~~ 18a...18k. Simultaneously demodulating each frequency interval with amplifying and preprocessing units ~~102.a...102.n~~ 102a...102n again results in the calibration or weight coefficient. Again these coefficients can be implemented in the software or directly applied to the PIN switches of the driving unit 109.--

Please amend the third paragraph on page 30 as follows:

--As mentioned above, this type of generation mode is also characteristic, for instance, for electron-wave tube systems with a delayed feedback in the band of their transparency that originally gets several natural frequencies of the systems. Figure 10 illustrates a delayed feedback stochastic s-mmw oscillator 650 that is based on traveling wave tubes. The system comprises two traveling wave tubes (TWT) 651 and 652, whose operation principle is similar to that of a ~~BWT, ,~~ BWT, a directive coupler 655 for taking part of the system radiation into the delayed feedback, and some attenuators 653, 654 for controlling the level of the radiation entering from the feedback.--

Please amend the first full paragraph on page 32 as follows:

--Both the IMPATT diode and the resonator/antenna circuits can be fabricated on a top surface of a semi-insulating GaAs substrate. As shown in Figure 11a, which provides a plan view and Figure 11b, which provides a cross-sectional view, a resonator/antenna circuit 400 formed on substrate 407 includes via holes 402 that are

used to ground one terminal 405 of each diode 410a, 410b. The radiating element 415, which also serves as a resonator for a pair diode, can be a micro-strip antenna. The oscillation frequency and the radiation pattern are determined by the properties of the on-chip circuitry. The bias is fed to the diodes 410a, 410b via a coaxial feed 420 from the back of the ground plate 425. A bond wire 426 needs to be used to connect the resonator 415 to the coaxial (or another type) fold.--

Please amend the second full paragraph on page 32 as follows:

--The dc current level controls the emitted power of the IMPATT diode. A "polychromatic" ~~source 121~~ source 12 of radiation based of IMPATT diodes with different emitting frequencies may be fabricated as presented in Figure 12a, which shows an array emitting the radiation with polarization features matched for a particular receiving element. When maximal signals are required at the receiver side, each diode (emitting at a different frequency) can be preferentially oriented with respect to antenna coupled receiver elements such that frequency and polarization sensitive detection is maximal for the co- or for cross-polarization state. The L_1, L_2, L_3, ... are the directions of the best or co-polarized ~~(Figure 12b~~ (Figure 12b) of the antenna coupled receiver 185 and the worst or cross-polarized (Figure 12c) of the antenna coupled receiver 190 sensitivity of the receiver antenna. Any other required sensitivity can be implemented by selecting the appropriate orientation for each source with respect to the receiver antennas. Each emitting element of the array may be realized as a doublet (or multiplet) spectral line source with embedded circuits for controlling the frequency shift between the doublet components (as will be discussed below).--

Please amend the fifth paragraph on page 33 as follows:

--In the case of partial narrow band sources, which are sweepable over a sufficiently wide sub-range (being distinct for the different sources), sweep generator(s) 808 is connected to the sources 801, 821, 822. Each sweep generator 808 is driven in its turn by the pre-processor 818 by means of time duration synchronizing block 815

according to the self-adapting algorithm. A source power driver 809 is coupled between block 815 and mmw oscillator 801.--

Please amend the first paragraph on page 34 as follows:

--All the wave-guide outputs of the partial source channels are coupled by means of coupler units 805 and 806 to couple horn 807. In this manner, every spectrally different component of the ~~“polychromatic’~~ "polychromatic" s-mmw radiation is directed into free space through the same horn 807. The composite unit creates the same emission origin for each component of the radiation. This feature is preferable for imaging technologies in which equal paths for partial component fields is desirable (e.g., two-frequency imaging, doublet imaging and so on).--

Please amend the second paragraph on page 35 as follows:

--For a monolithic realization 195, part of the elements ~~196 .a, 196.n~~ 196a, 196n may be located directly at the plane of paired VCO. This is shown schematically in Figure 15. Here the IF and LF signals processing scheme may be located out of the emitting plane.--

Please amend the second full paragraph on page 36 as follows:

--To provide a plurality of partial images for processing (e.g., for accumulation to reduce speckle and ringing), the spatially extended array of scattering elements can be used. The phase difference of radiation scattered by different elements of the array are time-varied and should vary over more ~~than 2□~~ than 2π. Therefore, the receiving apparatus of the imaging system should utilize an equivalent “exposure” time that is longer than the characteristic time duration of the phase variations.--

Please amend the second full paragraph on page 38 as follows:

--Because true spatial information about an object in slightly reoriented images of the object will be practically the same (when the frame rate is sufficiently high) and, at the same time, their speckle structures will be distinctly different, the set of such images

(technique of fast frames) is a complementary one for the procedure of enhancing the resultant image. This technique is attractive when the system allows fast recording of multiple frames for contraband detection due to the fact that any human carrier of the contraband practically always makes involuntary body movements, even while standing still, and, of course, when in motion. These movements allow a set of snap partial images (frames) with different speckle distribution for the nearest foreshortening of an observed object. The rate of obtaining of such frames of the image should be rather high, for providing of snap of rather small changes of object foreshortening. These conditions are acceptable for s-mmw imaging apparatus where the acquisition rate may be higher ~~than 1 □s~~ than 1 μs per frame.--

Please amend the third full paragraph beginning on page 40 and ending on page 41 as follows:

--Figure 17a illustrates a cross-section of one impedance-loaded antenna element 1500 (labeled as element 30 in the array 14). ~~30 of the array 14.~~ Figures 17b and 17c show the same antenna ~~element 30~~ element 1500 along with typical radiation patterns, as will be discussed below. In this embodiment, each impedance-loaded antenna comprises two conductive antenna parts ~~36 and 38~~ 1540 and 1545 and is equipped with two contacts (or ports) ~~32 and 34~~ 1510 and 1520, which may provide a bias (when it is needed) and/or a LF (low frequency) modulation signal for driving a load impedance of the scattering element. When the impedance of the load (which can be some nonlinear ~~element) 40~~ element) 1530 is fully matched to the impedance of antenna element ~~36/38~~ 1540/1545, the incident radiation is scattered in some "specular" way (in accordance with the antenna pattern) as shown by the scattering ~~indicatrix 44~~ indicatrix 1501 in Figure 17b. In the case where the load is completely mismatched, the scattering ~~indicatrix 42~~ indicatrix 1502 being primarily "specular" becomes essentially more "diffuse"~~(502)~~. This latter case is shown in Figure 17c. Because such changes of scattering properties of the diffuser elements in time can be realized independently of each other by means of independent modulations of their loads, the radiation scattered by the whole diffuser appears to be diffuse and spatially non-coherent.--

Please amend the first full paragraph on page 41 as follows:

--By switching the load between matched and unmatched impedance values, the radiation field scattered by the ~~element 30~~ element 1500 can be controlled and modulated. Applying an electrical or optical modulating signal to the combined scattering ~~element 30~~ element 1500 can perform the impedance switching.--

Please amend the second full paragraph on page 41 as follows:

--The antenna scattering patterns depend on the magnitude of the impedance of the antenna ~~load 40~~ load 1530. This impedance can be matched or mismatched with the antenna ~~36/38~~ 1540/1545. Moreover, specific impedance values (including reactive loads) are known in the art to be able to decrease the level of scattered radiation, scattering in particular directions, up to negligible values. This effect is similar to techniques used in radar and satellite applications where the back scattering cross section of coherent radiation can be controlled by driving the antenna load.--

Please amend the third full paragraph on page 41 as follows:

--The impedance ~~load 40~~ load 1530 of the ~~antennas 30~~ antennas 1500, and the principle of their modulation, can be different in nature. As examples, the loads can include Schottky diodes or Bismuth bolometers, or even two-terminal to three terminal microelectromechanical switches (MEMS). The loads can also go from photo conductor up to phototransistor. In practical implementations the elements of the diffuser will be similar. Accordingly, while specifically included as an aspect of the present invention, it is unlikely that a combination of bolometers, P-I-N diodes and photoconductive elements would be commercially practical within a single diffuser 14.--

Please amend the fourth paragraph beginning on page 41 and ending on page 42 as follows:

--Different approaches exist for realizing the modulation of the loads of the antennae. The bolometer resistance, for example, can be changed due to resistive heating

and cooling by a modulated (e.g., LF) electrical signal, for instance, applied to the ~~load 40~~ load 1530 through the antenna ports ~~32 and 34~~ 1510 and 1520. The modulation signals may be applied to the antenna elements through coils designed such that electrical modulation signals are perfectly transmitted and the millimeter wave radiation signals perfectly blocked.--

Please amend the second full paragraph on page 42 as follows:

--When no modulation signals are applied to the elements of the diffuser array 14, the spatial coherence level of the radiation emitted by the s-mmw source will be unchanged and remain very high. In that case, the rough surfaces of the object are known to introduce random distortions of intensity levels in the image at the receiver array plane due to the speckle effect. By distinctly modulating the impedance loads 40 of the differently located elements 30 of the diffuser array 14, the back-scattering cross sections of the different array elements are distinctly modulated and hence this embodiment allows the destruction of the spatial-coherence of the radiation and, as a consequence, the minimization of the speckle distortions in any obtained s-mmw image.--

Please amend the second full paragraph on page 42 as follows:

--When no modulation signals are applied to the elements of the diffuser array 14, the spatial coherence level of the radiation emitted by the s-mmw source will be unchanged and remain very high. In that case, the rough surfaces of the object are known to introduce random distortions of intensity levels in the image at the receiver array plane due to the speckle effect. By distinctly modulating the impedance ~~loads 40~~ loads 1530 of the differently located elements 30 (1500) of the diffuser array 14, the back-scattering cross sections of the different array elements are distinctly modulated and hence this embodiment allows the destruction of the spatial-coherence of the radiation and, as a consequence, the minimization of the speckle distortions in any obtained s-mmw image.--

Please amendment the third paragraph on page 43 as follows:

--The ~~radiation 28~~ radiation 26 (Figure 2) scattered by such antenna array 14 will contain spectral components, which are shifted relative to the carrier frequency of incident radiation. In an ideal system, these frequency shifts are strictly equal to the frequencies of the modulating signals applied to the different antenna coupled loads. A multi-element array 14 of impedance loaded antennas with different modulation frequencies for spatially distinct elements 30 is able to scatter spatially non-coherent radiation even if the different antenna-coupled loads are modulated with only slightly different frequencies of modulation signals. The later is especially valid if the receiving apparatus of the imaging system can provide duly temporal integration of the received signals. The integration procedure, which can be realized in different ways, aims to eliminate any inter-modulation products of different spectral components of the electrical signals. The latter can be important if only energy of the spectral components is responsible for energy of the correspondent partial images.--

Please amend the second full paragraph on page 46 as follows:

--In another embodiment, a simple realization of a spatially coherence destroying diffuser is based on the usage of elements allowing electrically changing the distance between a particular radiation scattering element of the diffuser and the total diffuser substrate. The range of the distance changes is not more than half of longest wavelength ~~$\square_{max}$~~ $\underline{\lambda_{max}}$ of used wavelength spectrum.--

Please amend the second full paragraph on page 47 as follows:

--Another possible realization is presented in Figure 20b. This implementation is a relatively inexpensive variant that can be used for spatially non-coherent imaging goals in s-mmw range. The radiation scattering elements 1050a, 1050b, ...,1050n are connected with the ~~substrate 1070~~ substrate 1020 by means of spring connections 1060a, 1060b, ..., 1060n providing the spatial displacements over required limits.--

Please amend the fourth full paragraph on page 47 as follows:

--Figure 21 shows another diffuser that is able to destroy the spatial coherence of s-mmw radiation. This embodiment uses a set of transmitting or reflecting cells 1100.a, 1100.b,..., 1100.n containing liquid crystal (LC). Low frequency voltage signal sources 1120.i, 1120.j, e.g., being distinct for each cell, are able to drive dielectric properties of the liquid crystal inside the independent cells. The changes in properties will be made in an independent and random manner that causes the independent modulation of the transmitting features over the whole aperture of such composite device for s-mmw radiation. Spatial coherence of s-mmw radiation beam after ones interaction with the diffuser will be destroyed. Possible time and geometrical features of such diffuser are defined by the design of the cells and the kind of liquid crystal that is used. Such diffuser may be used as an effective means for enhanced quality s-mmw imaging.--

Please amend the first paragraph on page 48 as follows:

--A first preferred mode is the dynamic scattering mode (DSM) in nematic liquid crystals (NLC), the simplest form of liquid crystal structures. These NLC require relatively low resistivity material (e.g., < ~~10G□.cm~~ 10GΩ.cm) and favor negative dielectric anisotropy. The NLC orientation is influenced by ionic current flow and dielectric torque. At a threshold voltage, a striped pattern known as the Williams domains appears. Further increasing the voltage generates the DSM, a turbulent state that scatters light strongly. The DSM is a form of electrohydrodynamic instability. This DSM also appears in smectic-A phase (which features an additional positional order with respect to the orientational order of NLC) and has the advantage that the electrically induced scattering texture is stored when the voltage is removed. Moreover, the scattering texture can be electrically erased with higher frequency voltages on the order of kHz.--

Please amend the first full paragraph on page 49 as follows:

--Figure 23a shows a multi-layer diffuser operating in reflection mode. The backside 300 is a corrugated metallic layer, reflecting broadband s-mmw radiation. The other set of layers 305, 310, 315, 320 preferably comprise transparent materials. Preferably two consecutive layers consist of dielectric materials with sufficient but not

too big dielectric differences in order to obtain sufficient radiation traveling through all the layers and sufficient diffusing. In the preferred embodiment, the layers are transparent dielectric materials such as Polycarbonate, polyolefine, polyethylene, polypropylene, rexolyte, ~~duroid~~ a polyester material such as DUROID™, which is commercially available from Rogers Corporation, ~~mylar~~ a polyester film such as MYLAR™, polystyrole, ~~teflon~~ synthetic resinous fluorine-containing polymers such as TEFLON™, ~~stycast HiK~~ a proprietary homogeneous light-permittivity and lossless material such as STYCAST Hi-K™, silicon, germanium, or combinations thereof.--

Please amend the last paragraph beginning on page 50 and ending on page 51 as follows:

--Another implementation of a wide band diffuser is shown in Figure 24. The multi-layer structure once again includes a reflecting backside mirror 350. The layers on top are heterogeneous layers comprising host materials 355, 365, 375 and 385 and guest materials 352, 362, 372 and 382. As shown in Figure 24, each guest material is disposed within a respective one of the host materials. The size of the particles 352, 362, 372, 382 at each level is in a well-defined geometrical range in accordance with the frequency band of the wide band radiation. Hence the different frequency bands of the radiation scatter at different levels of the heterogeneous multi-layer. The particle size ranges increase from the front side 385, 382 towards the backside 355, 352. The same diffuser device can be converted in a transmission mode operation by removing the metal layer. Transparent dielectric materials such as polycarbonate, polyolefine, polyethylene, polypropylene, rexolyte, ~~duroid~~ a polyester material such as DUROID™, which is commercially available from Rogers Corporation, ~~mylar~~ a polyester film such as MYLAR™, polystyrole, ~~teflon~~ synthetic resinous fluorine-containing polymers such as TEFLON™, ~~stycast HiK~~ a proprietary homogeneous light-permittivity and lossless material such as STYCAST Hi-K™, silicon, germanium, and others are preferably used as the dielectric host material. Combinations of these materials can also be used.--

Please amend the second full paragraph on page 51 as follows:

--In one aspect, the present invention provides generating radiation that includes multiple phase-independent partial components exhibiting distinguishable physical features. As examples, these features may include the angles of partial components' propagation (which is equivalent with the angle of incidence of the partial component on the surface of observable object), radiation carrier central frequency, or its polarization. As was ~~discussed ,~~ discussed, each of these features provides information about the object being irradiated and this information can be used to enhance the visual quality of the object and/or to recognize one correctly.--

Please amend the third paragraph on page 53 as follows:

--For example, as illustrated in Figure 25a, if the diffuser is illuminated only by narrow spectral band linearly polarized radiation, then partial images 760, 765,… 790 may be produced by radiation components exhibiting the same radiation carrier frequency and polarization state but exhibiting different angles of incidence with respect to the surface of observable object. In this case, the summed ~~image 300~~ image 800 of the partial images 760, …, 790 will be physically equivalent to the image produced by monochromatic linearly polarized radiation, which is spatially non-coherent near the surface of the object. It is common knowledge that such spatially non-coherent image 800 will show enhanced visual quality with substantially reduced speckle structure. At the same time it will be a precisely defined polarized one-frequency image comprising the object information (object imaging details), which may be only visible on considered image exhibiting said specific polarization and carrier frequency.--

Please amend the last paragraph beginning on page 53 and ending on page 54 as follows:

--If the diffuser is illuminated by radiation exhibiting another carrier frequency, then another non-coherent precisely defined one-frequency image 1325 (see Figure 26) will be synthesized based on the stack 1310 of angular decomposed images for this carrier frequency or/and polarization state of the radiation. The synthesized image 1325 at this frequency may reveal another intrinsic set of object image details than the image 1315 synthesized from the stack 1310 on angular decomposed images. Because the diffuser

may be illuminated with multi-frequency radiation, whereby every one-frequency component is individually encoded (e.g., modulated), then the correspondent one-frequency images may be individually selected by processing means just by choosing the correspondent partial images 1320 from the whole set of such images being received simultaneously.--

Please amend the third full paragraph beginning on page 54 and ending on page 55 as follows:

--Coherent linearly polarized radiation source 12 ~~(Figure 2)is~~ (Figure 2) is used here for homogeneously illuminating the electronically controlled diffuser 14. Independent scattering elements of the diffuser decompose the coherent radiation, being incident on them, over independent radiation components. Because the scattering diffuser elements 700.11,...,700.kl,...,700.rs have distinct spatial localization relative to illuminated object, correspondent partial radiation components will exhibit distinct angles of incidence with respect to surface of the object. When scattering properties of distinct diffuser elements are modulated with different frequencies 705.11,...705.kl,...,705.rs, then the carrier frequencies of scattered components will have distinct AM frequency sidebands being precisely and individually shifted relatively to primary carrier frequency of the incident radiation, as illustrated in Figure 27b.--

Please amend the second full paragraph on page 55 as follows:

--When the principle of ordering the diffuser elements in some set of cluster elements is used, the number of the distinct angular partial images may be effectively reduced. This principle is illustrated in Figure 28.. A group of scattering elements 551b,...,558.b belonging to the same frequency interval $f_{i,n}$ ~~551a, ..,558.b~~ 551b,...,558b are shown. The spectral composition of different frequency intervals 551-558 is indicated on the diffuser array 14.--

Please amend the second paragraph on page 58 as follows:

--Mirror-like subparts of the object 16 can degrade the total image quality by producing bright, localized spots in the image. This is known as the glint effect. Such excessive brightness can easily cover details of the object 16. As shown in Figure 30, rays 61 and 62 impinge upon a specular reflection region 160 and are converted into rays ~~85 and 86~~ 81 and 82, which produce bright spots on the receiver array 18. The scattered rays 63, 64 and 65 impinge upon a diffuse region 165 of the object 16 and are converted into much less intensive rays 83, 84, 85. When these rays reach the detector array 18, they are not observed due to the dominating field intensity produced by rays 81 and 82. Such glint effect due to the geometrical characteristics of the object 16 can be eliminated when scattering element 14a is properly clustered in a set of modulation frequencies for encoding of angular information. This technique provides the possible decomposition of the signal of every pixel of a received image over partial signals being responsible for correspondent partial images, produced by different radiation component exhibiting distinct angle of component propagation each of which is simultaneously recorded at different angles of incidence.--

Please amend the last paragraph beginning on page 58 and ending on page 59 as follows:

--When the localization of the different modulation frequency characteristics is stored in computer memory, one can deduce the geometrical characteristics of the object and its orientation. When some specific modulating frequency interval(s) are well localized and produce highly peaked signals in the detector array, one can deduce for example that the scattering elements of the frequency clusters 555a-557a (see Figure 31) are located such that their corresponding radiation was predominantly scattered on a mirror-like surface 160 of the object 16. A typical detector signal for that case is represented by curve 560 in Figure 32. Signals from the frequency clusters ~~551-554, 558-559~~ 551a-554a, 558a-559a, however, is reflected on diffuse ~~parts 72~~ parts of the object and results in broadly spread detector signals illustrated by curve 570 of Figure 32. This modulation technique allows the reduction of any influence of disturbing signals on the quality of resultant image by means of aposteriory image processing.--

Please amend the second full paragraph on page 59 as follows:

--In the case where the diffuser 14 is based on vibrating elements for eliminating specular reflection, the elements creating strong specular signals may be automatically oriented for the time of a particular imaging by such manner that radiation scattered by them will propagate past an observable object or, at least, will not enter the pupil of the imaging system. For a majority of diffusers of another type some, analog approaches of real-time eliminating of the glint effect may be effectively exploit as <u>well.</u> ~~well..~~--

Please amend the second full paragraph on page 66 as follows:

--Enhanced stabilization of the frequency and essentially enhanced phase properties of the beat signal being produced by the doublet components at the mixer 846 can be achieved if the chain producing the beat signal (VCO's and the mixer) are phase locked by a reference oscillator 858 producing a highly stabilized lower frequency signal. The reference oscillator may be an oscillator stabilized by quartz with an extremely high quality factor Q (which can range from 1,000,000 up to 1,000,000,000). The beat frequency is compared to harmonics of the reference signal at the harmonic mixer 857. <u>An N^{th} harmonic multiplier block 860 is coupled between oscillator 858 and mixer 857.</u> The output of the mixer 857 is electrically connected to the ~~VCO 849~~ <u>VCO 853</u> through operational ~~amplifier 860~~ <u>amplifier 855</u>. The described phase lock loop (PLL) can include, as well, a linear frequency/phase ~~discriminator (859)~~ <u>discriminator (852)</u> followed to the harmonic mixer.--

Please amend the last paragraph beginning on page 67 and ending on page 68 as follows:

--The received doublet signal may be amplified in any heterodyning amplification circuits. Such circuits are known to be based on down-converting the frequency of received signal up to IF range with subsequent additional amplification of the signal by IF amplifiers. Any down-converting is preferably performed for both doublet components in the same way so their difference will not be changed at all in any heterodyning circuits. Moreover, phase noises of local oscillators (LO) of the heterodyning stage will not influence the resultant beat signal at all because they will be added to every doublet

component in the same way and will be automatically self-deleted from the beat signal after the self-mixing of the doublet components. It is a big advantage of the proposed transceiver FM apparatus because in case of heterodyning amplification of standard FM signal, phase-noise features of the local oscillator have a big impact because the LO phase noises will be automatically transferred to the received signal after correspondent heterodyning of the signal. Hence the stabilization of the LO-frequency is a critical issue in the design of heterodyning circuits for standard FM signals. ~~signals mixed signal is inversionally proportional to the~~ In the case of doublet spectral components this stabilization issue is not important.--

Please amend the third full paragraph on page 71 as follows:

--Co-polarized doublet radiation may be used for polarization imaging as well if the polarizing grid 23 of the imaging system is oriented to block the radiation 28 when the primary polarization state of one of the components is not changed by a scattering object 16. However, cross-polarized doublet radiation is preferable for polarization imaging in comparing with co-polarized ones due to better polarization sensitivity of receiving apparatus for the same imaging conditions. The latter teaches that the choice of the polarization state of the doublet determines for which kind of materials of the object the imaging system is most ~~sensitive~~ sensitive.--

Please amend the third full paragraph on page 74 as follows:

--The aforesaid principle of doublet line decomposition of object illuminating radiation is preferable for a majority of ~~applications.S mmw~~ applications. S-mmw VCOs, however, can be further extended to multiplet line decomposition of the radiation as well. A multiplet line decomposition is defined as a set of doublets whose central frequencies are very close to each other but with each doublet of the multiplet characterized by a distinct frequency difference as illustrated in Figure 39. The principal of ordering the spectral components of the shown multiplet 420, comprising of three doublets is as follows: doublet 1 (2; 3) has spectral components 411a, 411b (~~412a, 412b ;~~ 412a, 412b; 413a, 413b) and frequency differences 414 (415; 416) respectively.--

Please amend the third full paragraph on page 76 as follows:

--For illustrative purposes, one doublet (with spectral line ordinal number 1) exhibits the first organization rule of doublets. The snapshots for this doublet are shown in Figures 40b and 40c at different moments of time delayed from each other by half an oscillation period of correspondent beat frequency ($\omega_{d\,1,1} > 0$). Snapshots of another doublet (ordinal number 14) are shown in Figures 40d and 40e at the same moments of time. The beat frequency of this doublet has no dynamic part. In this case, the signal does not oscillate ~~(□$\omega_{d\,14,1}=0$)~~ <u>($\omega_{d\,14,1}=0$)</u>. The multiplet spectral line (its ordinal number in the total s-mmw spectrum is 24) comprises six spectral components, mutual spectral locations of which are non-varying in time (the second organization rule of ordering).--

Please amend the fourth paragraph beginning on page 76 and ending on page 77 as follows:

--The snapshots of multiplet m24 are shown in Figures 40f and 40g in analogy with the above-mentioned doublets. Multiplet 24 is ordered for producing three distinct beat signals, the frequencies of which are shown as ~~$\omega_{24,1}$, $\omega_{24,2}$ and $\omega_{24,3}$~~ <u>$\omega_{24,1}$, $\omega_{24,2}$ and $\omega_{24,3}$</u> respectively. Each distinct beat signal, carrying independent physical information about the observed object, will be produced by an independent particular doublet, the components of which exhibit the same radiation feature. When three beat signals of the multiplet 24 are produced, six independent spectral components are needed. In the general case, beat signals formed by spectral components exhibiting different radiation features will carry mixed information about physical and geometrical properties of the scattering objects leading to difficulties for value-to-value recognition of received image information arrays but sometimes it may be useful (for example in the case of cross-polarized doublet).--

Please amend the fourth full paragraph on page 79 as follows:

--The possible spectral composition of multiplet radiation (multiplet 24 and 25) and the spectrum of beat signals for all components of multiplet 24 are shown correspondingly in Figures 42a and 42b. The fine structure of beat signals shown in ~~Figures41b.~~ Figures 41b and 41c are schematically only depicted in Figure 42b. It will be shown that three different intervals in the beat spectrum can be distinguished. These intervals are distinguished by their origin of intermodulation products:--

Please amend the third paragraph beginning on page 85 and ending on page 86 as follows:

--Figure 47 illustrates three different curves to show the wide-band performance for different wire pitch irregularities. The different experimental curves show transmission coefficients of different wire polarizing grids 905, in which the wire pitch 910 was made to fluctuate according to a Gaussian distribution with selectable standard ~~deviation □~~ deviation σ. The grids wire diameter is equal to about ~~25 □m~~ 25 μm and the middle pitch is equal to about ~~100 □m~~ 100μm. It is clear that at lower frequencies, where the wire spacing remains much smaller in comparison with the wavelength, the transmission coefficient slightly changes with rising mechanical imperfection of the grid. At higher frequencies, where the spacing is comparable to the wavelength, the transmission coefficient rises sharply for fractional deviation above about twenty-five percent. If accurately manufactured, such kind of grids should have an extrapolated upper frequency limit of about 1 THz for a wire diameter of ~~10□m~~ 10μm if 1 % transmission of the cross-polarized radiation is considered to be sufficient for polarization imaging. Such wide-band operation is quite sufficient for proposed multi-frequency imaging technique.--

Please amend the second paragraph on page 87 as follows:

--Another type of antenna, suitable for monolithic realization of the integrated receivers is the end fire (traveling wave) ~~antenna .~~ antenna. Due to peculiarities in its construction - they are extended in the direction along the optical axes of quasioptical system - they make correspondent 2-D receiver arrays very compact because they allow the z-axes (being parallel to the optical axes) for propagation of the imaging radiation and

allow to provide the X-Y plane (perpendicular to the z-axis) for the non-linear elements and interconnections. All these antenna exhibit wide band performance and medium gain patterns. One typical such antenna is a tapered slot (Vivaldi) antenna, which presents an exponentially tapered slot which can be etched on metallized dielectric substrates. Such antennas may provide 3 dB beam width for two frequency octaves at least.--

Please amend the second full paragraph on page 88 as follows:

--Another embodiment receiver 200 is presented in Figure 49, which includes Figures 49a and 49b. Figure 49a illustrates a compact wide-band receiver unit where pumping multiple mixers are pumped in a quasi-optical way. A two-dimensional array of integrated mixers is disposed on thin dielectric membrane 210. The membrane material may be either any soft dielectric material (~~e,g., mylar~~ e.g., MYLAR™, or others) or hard ones (e.g., ~~Duroid~~ DUROID™, or others) depending on the operating frequencies of the unit. The thickness of the membrane needs to be chosen such that substrate modes are not excited in the membrane. The number of mixer element needs to be limited in order to provide an appropriate topology for any biasing/output connections of the mixer elements located in the same plane.--

Please amend the last paragraph beginning on page 88 and ending on page 89 as follows:

--Image radiation 228 impinges a thin penetrative membrane 210. Local oscillator (LO) radiation 214 is generated by s-mmw frequency sweeping source/isolator 216 and directed toward membrane 210 through a directive structure 218. The receiver array is disposed on a penetrative substrate 210 (without grounded metal plate). LO radiation 214 can be incident on the substrate 210 from direction being opposite to the direction of propagation of imaging radiation. This configuration makes the imaging system 200 more compact because ~~ones~~ one does not need any quasi-optical diplexing elements. The size of such unit 212 should not be overly extended since the bias and output IF signal leads 224 ~~(Figure 24b)~~ (Figure 49a) should be able to output the signals from the array elements 212 without mutual electrical coupling.--

Please amend the first full paragraph on page 89 as follows:

--The total mixer receiver array can be composed from a set of sub array units 215a...215n every of which has a limited number of receiver elements and is provided by individual LO source as shown in Figures 49a and 49b. The proposed geometry of the units allows all components of the heterodyning scheme (including the IF amplifiers) to be configured in a compact way while allowing the creation of as big an array as needed. The design allows providing wide band radiation, pumping the mixer elements and such pumping may be done in subharmonical regime. The mixers can also be operated in the homodyning mode if the radiation of the powerful LO is used both for pumping all the units of the array as well for illuminating the field of view of imaging system. This is achievable when the LO radiation is split in the appropriate way.--

Please amend the third full paragraph on page 95 as follows:

--In the SAT module C_1 of Figure 50c, the signal received by ~~antenna 2030~~ antenna 2031 is immediately down-converted up to IF range in mixer 2034, which is pumped by a local oscillator signal having a frequency Δ_1. (PIN diode switch 2030 may be additionally inserted in front of the mixer 2034 if the module C1 will be used for passive radiometric imaging as well.) The module C_1 of Figure 50c can be ended by carrier demodulation block 2037a or 2037b discussed above in connection with SAT module A1 of Figure 50a.--

Please amend the first full paragraph on page 97 as follows:

--The SAT module E_1 may need to be modified. For example the receiver element 2030 may be followed by IF amplifier (like ~~2001~~ 2034 of Figure 50d) and even down-converting block (like 2001 of Figure 50d) depending on frequency features of applied doublet modulation of the radiation. The latter blocks are able to essentially enhance signal-to-noise and extends the bandwidth of the SAT module E_1.--

Please amend the third paragraph on page 98 as follows:

--The latter may be effectively exploited for speckle-free imaging, which can be realised even if the observable objects (having any kind of surface roughness) are illuminated by spatially coherent multiplet radiation as it was discussed above. The amplitudes of the beat signals at output of ~~block 2046a~~ block 2003 of SAT modules A1-E1 will be proportional to the intensity (but not to the amplitude as it takes place for traditional active imaging) of radiation scattered by those small parts of the observable object at which the receiver element 30 of the considered receiving channel looks at.--

Please amend the first paragraph on page 100 as follows:

--All other signals will be effectively rejected. In considered case the output k of module F2 in Figure 51a should be directly connected to the multiplexer 130 of Figure 6. If the spatially non-coherent imaging system being based on ordered angular decomposition of the object illuminating radiation is employed, then as it was discussed the spectrum of the imaging beat signals, being produced by block 2037a of any of the SAT blocks A1-E1 will exhibit precisely extended spectrum. Thereby the fine structures will be strictly ordered in such way that the spectral shift of any spectral component of the spectrum relative to the primary beat frequency $\omega_{s,24,1}$ - without any loss of generality one referred as an example to doublet n=1 of multiplet m=24, the beat signal frequency of which is equal to the static value $\omega_{s,24,1}$ - will be precisely equal to the modulation frequency of a signals, which modulates a particular scattering element of the diffuser. In other words, information parts of extended spectrum 565, 563, 570, 568 in ~~Figure 42b~~ Figure 41 was shown to be some additive set of spectral components every of which is responsible for radiation scattered by particular diffuser element and having a spectral component precisely shifted from frequency $\omega_{s,24,1}$ with a value of frequency of the element modulating signal $\Delta\omega_1$. (Generally the number of independent spectral components in the information spectrum structures 565, or 570 an so on is equal to the number of the diffuser scattering elements). After second down-conversion of the signal at block 2041 of module F2, the spectral components of the information spectrum part 565, 570,... will be shifted relative to offset to values being exactly equal to modulating frequencies of diffuser elements $\Delta\omega_{1el}$. In this case if only angular information spectrum

part is of interest (565,563 or 570,568) the filter ~~2051a or 2051b~~ 2062 or 2063 have to be band-pass and to exhibit $\Delta\omega_0$ (see 565,570) bandwidth (being equal to the bandwidth of the information spectrum parts) and centred around the centre frequency of the diffuser modulating signals $\Delta\omega_1$.--

Please amend the second paragraph on page 105 as follows:

--Generally quasi-optical refractive lenses, used as a focussing element 21 for multi-frequency imaging need good imaging properties over a large field of view (+/-30 degrees) and preferable quasi-identical properties within the whole frequency band of imaging system. It is known that for a refractive lens the best focus, as a rule, lies on a curved surface. This fact may be partially corrected by disposing every element of receiving array (or a subarray of receiving ~~elemens~~ elements) individually on the same plane, whereby the planes tangentially coincide with the specified curve surface for optimal focussing. In general, to eliminate or minimize off-axis phase aberrations of the imaging lens 14, such lens design need to be subjected to a fully analytical treatment for optimizing a multi-component optical focussing system for multi-frequency radiation, at least, the possibilities to vary profiles for every said lens component and their mutual locations. It is obvious that ~~tge~~ the material of the different lens components need to have the same refractive index and absorption.--

Please amend the fourth paragraph beginning on page 105 and ending on page 106 as follows:

--For s-mmw imaging diffractive focussing elements may be of great interest. Typical class of such focussing element is Fresnel zone plate lens. It is ~~well know~~ a well-known fact that the resulting focal length of such lens depends on the wavelength of imaging radiation. When the distance d in Figure 54 between the Fresnel lens 3000 and the receiving array is kept constant, then the planes 3005, 3010,...3020 of the observable scene (perpendicular to the lens ~~eaxis~~ axis) which can be focussed at the receiving elements 18, will vary with the wavelength of imaging radiation (s1, s2, s3,...). These wavelength dependent distances from the planes towards the lens are indicated in the

exemplary figure 54 by the indices S1,...S4 for four distinct wavelengths. It is of great of interest for s-mmw frequency range where the frequency of s-mmw sources may be varied over the 20 per cent and more of its central frequency. But said imaging possibilities had no ~~any~~ practical meaning up to now, because the used s-mmw source radiation exhibited high coherence that ~~lead~~ led to speckled imaging with very bad visual quality. The situation may be totally changed if spatial coherence of the s-mmw source (12a, 12b of Figure 54) radiation will be previously destroyed by any of the diffusers (14a, 14b of Figure 54) of preferred embodiments of this invention, and only after the destruction of the radiation's spatial coherence, the radiation will be redirected towards the observable scene 16. In this case, multiple enhanced visual quality images of distinct planes of the scene at different distances S1,S2,S3,... from the Fresnel lens 3000 may be obtained just by sweeping the frequency of s-mmw source 12. In other ~~words~~ words, a whole volume of observable scene will be scanned by sequentially imaging the different cross-section planes of the scene and this can be performed in real time.--

Please amend the fourth full paragraph on page 107 as follows:

--Figure 55 illustrates an observation room that can be used for this security purpose. To best organize the procedure, it may be useful to restrict the path of the human carriers to part of the observation special room by some device, such as railing 2012. The walls 2014 of such room 2010 may be covered by radiation coherence destroying diffusers (not shown), which are illuminated by a "polychromatic" radiation ~~source 20~~ source 2016. The imaging system 2018 (or several systems) may be located for the optimal visualization of the carriers. All elements may be under computer control and act in real time. A special computer system intended for processing multiple partial images for fast and reliable recognition of masked objects can be utilized.--